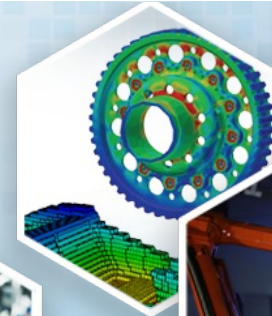
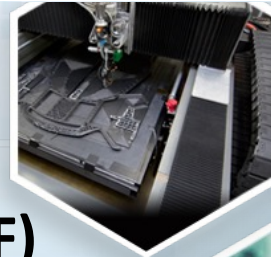


MSU Scale-up Research Facility (SURF) Update

Raymond G. Boeman, Ph.D.
Director, IACMI Scale-up Research Facility
Michigan State University

June 29, 2022



Michigan State University Facilities



Composites Materials & Structure Center,
Lansing



*7,500 ft²
Characterization and Processing Laboratory
Over \$5M in Equipment
Full-time staff -3 professionals and 2 technicians*

Composites Vehicle Research Center,
Lansing



Supported by TARDEC

- *Composite Joining*
- *Design & Manufacture*
- *Impact Resistance*
- *Multi-Functional Composites*
- *Self-Diagnostic Composites*
- *Structural Integrity*

IACMI SURF
Scale-Up Research Facility,
Detroit



Full-scale RD&D facility

- *Injection Molding*
- *Compression Molding*
- *Prepreg*
- *Tape layup*
- *HP-RTM*

MSU SURF Facility



April 2014



MSU SURF Facility



September 21, 2016



Large-scale prototype & run-at-rate capabilities

Typical Projects

- Prototype development
- Process/materials validation
- Run at rate validation
- Tool tryout

Major Capabilities

- 4000T compression molding
- 3000T injection molding
- Prepreg production
- Twin screw compounding
- HP-RTM (PU & Epoxy)
- Hi-throughput tape-lay-up



New Capability – Multiaxial Tape Lay-up



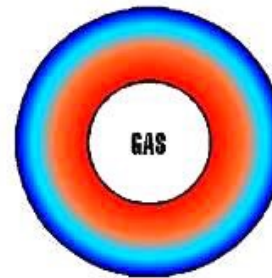
- ◆ Multiaxial laminates
 - ◆ Dry fiber
 - ◆ Thermosets
 - ◆ Thermoplastics
- ◆ Statement of requirements
 - ◆ 48 in x 48 in
 - ◆ Multiaxial lay-up
 - ◆ At least 6 layers in under 60 sec.



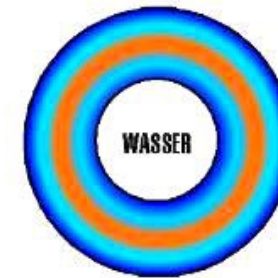
<https://www.youtube.com/watch?v=hgkoppa7u10>

Future Capability – Water-Assist IM (Fall 2022)

- ◆ Permit hollow sections
- ◆ Increased stiffness
- ◆ Mass reduction
- ◆ Reduces cycle time



einseitige Kühlung



zweiseitige Kühlung

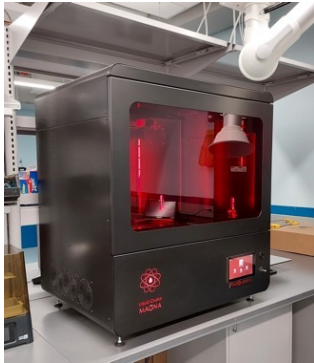


Injection molding cell



Component cross section

Application Technology Center BASF Forward AM Detroit, MI



Photocentric
Magna Printer

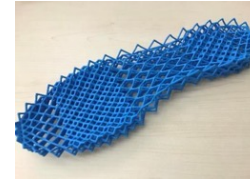


Powder
Bed
Fusion
lab

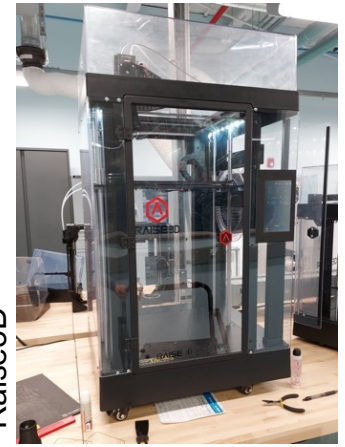
Photo
Resins
lab



Filaments
lab



XYZ 232 powder printer



Raise3D



Sponsor: Ford Motor Company
Prime Sponsor: DOE Vehicle Technology (FOA)

Start Date: October 1, 2020
Duration: 39 months
Funding: \$7,500,000

Partners: Ravago Americas LLC, Purdue University, MSU, Yanfeng Global Automotive Interiors, ORNL

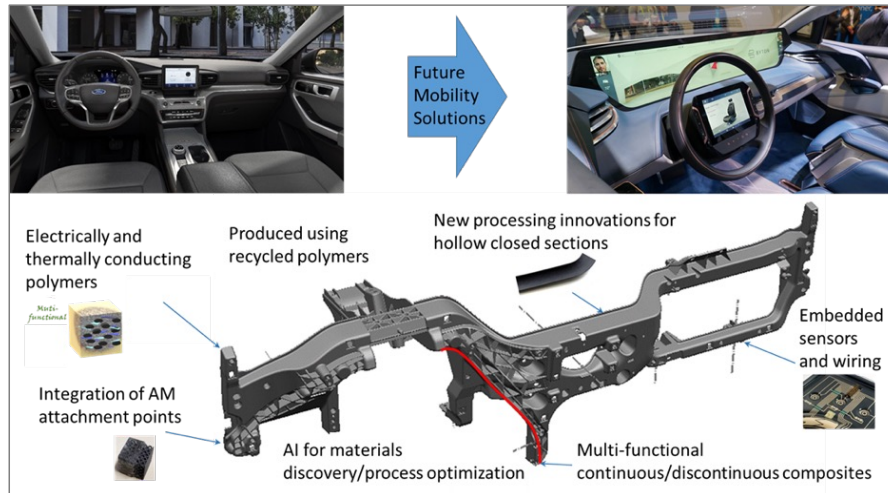
Opportunity: Demonstrate lightweight multifunctional instrument panel/cross-car beam for smart vehicles

Challenge: Development of novel conductive materials, integrated sensors, water-assist IM, robust process improvement through machine-learning

Impact: Key enabling technologies for improved end-user experience in smart vehicles

Approach:

- Novel conductive thermoplastic materials
 - Incorporating recycled materials
- Integrated sensors
- Additive manufacturing and tow-placement technologies
- Processing innovations for hollow closed sections



Structural Battery Enclosure (DOE)



Sponsor: General Motors

Prime Sponsor: DOE Vehicle Technology (FOA)

Start Date: October 1, 2020

Duration: 39 months

Funding: \$7,500,000

Partners: Coats, Columbia, Continental Structural Plastics, ESI, General Motors, MSU, USC

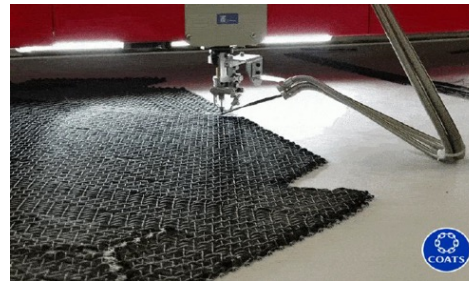
Opportunity: Enable light weight cost effective advanced composite material solutions for EVs

Challenge: Hybrid material systems (glass/carbon fibers), integral sensors with TFP preforms

Impact: Self health monitoring capability integral to component, high volume (HV) manufacturing for automotive, reduced defects, scrap, cost

Approach:

- Novel Tailored Fiber Placement (TFP) preforms
- Tailored resin distribution / drape for high volume manufacturing
- Development of integral sensors into TFP
- Process advancement including AI/Machine Learning



Representative Coats Preforms

Trimer – HP RTM molding (DOE SBIR)



Sponsor: Trimer Technologies (via CCS)

Prime Sponsor: DOE SBIR/STTR

Start Date: April 1, 2021

Duration: 17 months

Funding: \$1,100,000

Partners: Trimer, CCS, OEM

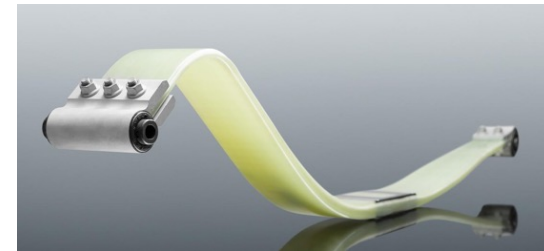
Opportunity: Novel resin technology for thick section composites, exceptional flammability (FST) performance

Challenge: Traditional Epoxy, Polyurethane chemistries not capable, unique high-volume manufacturing at SURF for this material

Impact: low exotherm, fast cycle time with thick section components, SuRF HP RTM capabilities well positioned to support development

Approach:

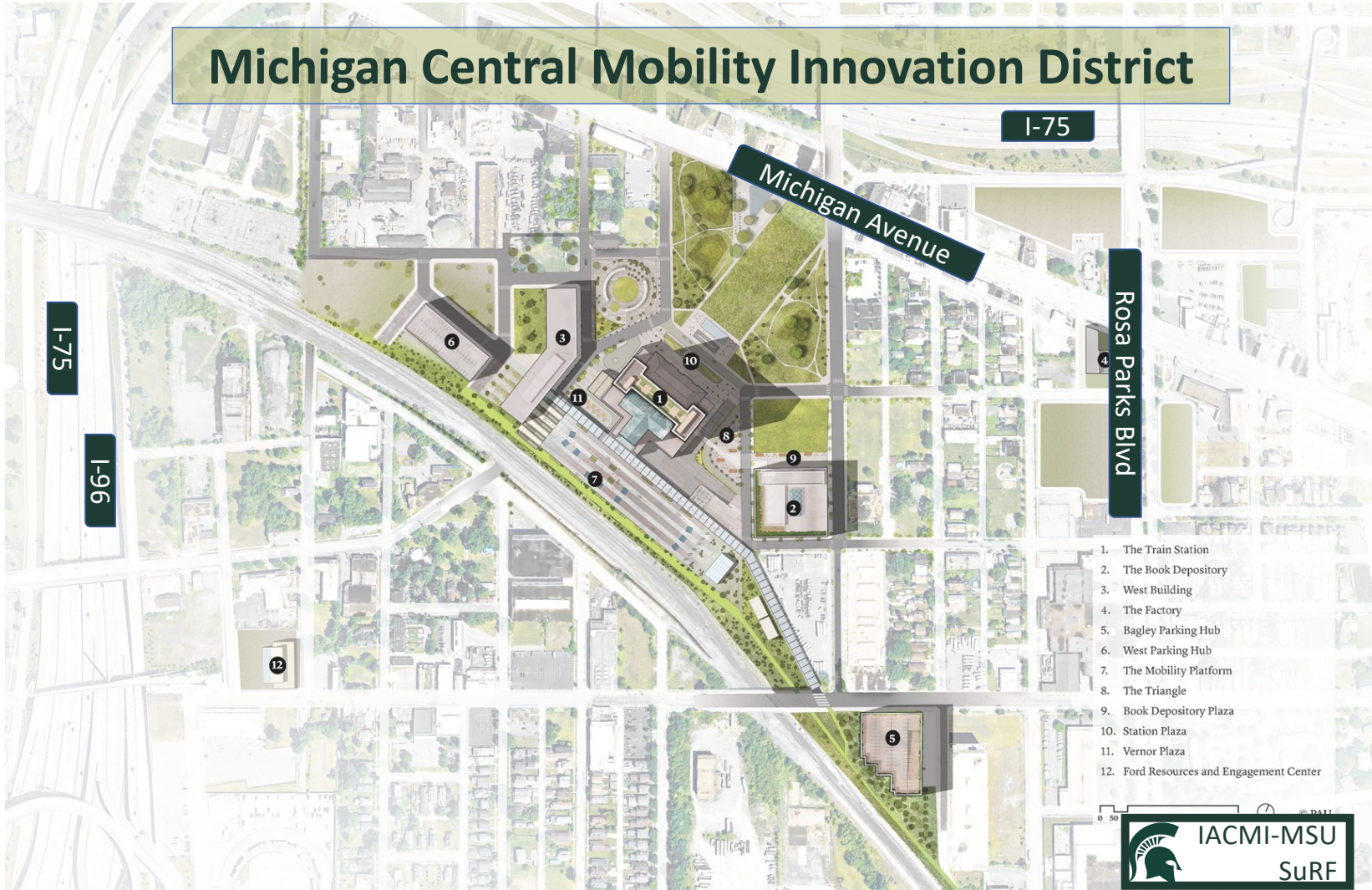
- HP RTM molding cell upgrade (ventilation)
 - Upgrade to accommodate PU material systems
- Demonstrate Trimer Technologies novel material system
- OEM leaf spring planned



Notional composite leaf spring for illustration only.

(www.mubea.com/en/composite-components)

Michigan Central Mobility Innovation District



1. The Train Station
2. The Book Depository
3. West Building
4. The Factory
5. Bagley Parking Hub
6. West Parking Hub
7. The Mobility Platform
8. The Triangle
9. Book Depository Plaza
10. Station Plaza
11. Vernor Plaza
12. Ford Resources and Engagement Center



M-10

IACMI/MSU Scale-up Research Facility



Thank You!